Name of Organization: USGS-Great Lakes Science Center

Type of Organization: Federal Agency

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Project Title: Effects of Invasive Species on Trophic Linkages in Lake Erie

Project Category: Exotic Species

Rank by Organization (if applicable): 0

Total Funding Requested ($): 66,388 **Project Duration:** 1.5 Years

Abstract:

The nearshore zone is an important nursery area for fishes of the Great Lakes. However, recent invasions of exotic invertebrates and fish have greatly altered the community. During the Lake Erie Millenium Conference in April, 1999, it was stated clearly that the role of invasive species in recent ecosystem changes is poorly understood, especially in coastal waters. Exotics may alter trophic interactions of juvenile fishes and determine whether a food web is planktonically or benthically driven. Understanding the changes in trophic interactions associated with invasive species is also important in determining biomagnification of contaminants through the food web. Are major contaminants obtained through sediments or water? How many trophic levels are needed to reach the top predator? A study is underway to document changes in in abundance and diets of juvenile fishes in nearshore areas of Lake Erie, which have well established populations of zebra mussels and round gobies. We propose to complement that ongoing study with stable isotope analyses of important juvenile fishes and invertebrates at the study sites. The stable isotope analyses will provide a verification of the important diet sources for juvenile fish and a measurement of their trophic level.

Geographic Areas Affected by the Project

States:

- ☐ Illinois
- ☐ Indiana
- ☐ Michigan
- ☐ Minnesota
- ☐ New York
- ☐ Pennsylvania
- ☐ Wisconsin
- ☒ Ohio

Lakes:

- ☐ Superior
- ☐ Huron
- ☐ Michigan
- ☒ Erie
- ☐ Ontario
- ☐ All Lakes

Geographic Initiatives:

☐ Greater Chicago ☐ NE Ohio ☐ NW Indiana ☐ SE Michigan ☐ Lake St. Clair

Primary Affected Area of Concern: Black River, OH

Other Affected Areas of Concern:

For Habitat Projects Only:

Primary Affected Biodiversity Investment Area:

Other Affected Biodiversity Investment Areas:

Problem Statement:

During at least a portion of their first year of life, 129 species of Great Lakes fish are found in lake habitats generally less than 2 m deep. However, this nearshore community has been notoriously understudied. Critical questions remain regarding the trophic interactions of nearshore juvenile fishes (including benthic or pelagic pathways) as well as the repercussions to energy and contaminant flow through the food web and into the offshore community. In addition, food webs in Lake Erie have been notably altered due to the presence of several exotic species including zebra mussel (Dreissena polymorpha), Bythotrephes cederstroemi, and round goby (Neogobius melanostomus). Stable isotope analyses have been useful in detecting changes in the food web structure due to introduced species. These analyses have also been useful in determing the importance of pelagic and benthic prey items to fish diets. Stable isotope carbon analyses provide an indication of the food source, and ranges in C13 values are related to the variability associated with the diet. Stable isotope nitrogen analyses provide information on the trophic level, which can be correlated with contaminant uptake in fish. Trophic classification is a key component of the Index of Biotic Integrity (IBI), which has been successfully used to classify aquatic systems as degraded or undisturbed. Ohio is the leader in the Great Lakes in using IBIs to assess quality of aquatic environments. However, information on trophic classification of young fishes, though required, is lacking for use in IBIs..

Proposed Work Outcome:

The proposed project will provide stable isotope ratios of carbon and nitrogen for important juvenile fishes and invertebrates of nearshore areas of Lake Erie. Samples will be collected in tandem with a concurrent study at nearshore sites associated with three river mouths in west-central Lake Erie -- the Black River (an Area Of Concern), the Huron River, and the Vermilion River. The ongoing study will provide diet and abundance information on the invertebrate and the larval and juvenile fish community at the three sites. However, diet information only provides a ‘snapshot' of trophic interactions. The stable isotope analyses in the proposed study will complement food diet information to determine food source and trophic level of nearshore juvenile fishes. Several species of fish are known to be abundant in the sampling area and include trout-perch, freshwater drum, gizzard shad, yellow perch, walleye, and round gobies. Other fish of historical interest in the area include burbot, whitefish, and lake herring. Five fish species will be chosen for stable isotope analyses based on abundance and historical importance -- tentatively we would include round gobies, yellow perch, freshwater drum, walleye, and burbot. Samples would include at least six replicates (individuals) for each of the five species, three sites, and two seasons (summer and fall). Invertebrates will be grouped into amphipods, mayfly larvae, zebra mussels, and Bythotrephes for stable isotope analyses with six replicates per group, site, and season; other invertebrates will be analyzed as composites of 'zooplankton' or 'other benthic organisms' with three replicates per group, site, and season.

The outcome of this project is to determine the changes in diet and trophic level of nearshore juvenile fishes in response to exotic invertebrates (zebra mussels and Bythotrephes) and fishes (round gobies). Comparisons of trophic linkages among sites will contribute to our understanding of the effects of habitat quality on the biotic components of the ecosystem, as the three sites we selected vary in quality from severly impacted (Black River, AOC) to less impacted (Vermilion River). We will determine if changes in stable isotope composition of invertebrates or juvenile fish vary among sites. In addition, we will determine if the juvenile fish of different species vary in their stable isotopic composition and whether we can relate these differences to their diet as determined from gut content analyses. We will also provide information on the trophic classification of various life stages of nearshore fishes which we currently lack for the Great Lakes. As Lake Erie has well established populations of zebra mussels and round gobies, we can use the information gained in this study to predict the consequences of their establishment on nearshore communities in the other Great Lakes. This will also provide information on the poorly known nearshore communities that are most affected by exotic species. Such knowledge is critical to formulation of the Lake Erie LaMP, which is concerned with the effects of exotics at the ecosystem level.

Project Milestones:	**Dates:**
Project Start	06/2000
Collect summer samples	07/2000
Collect fall samples	09/2000
Samples processed	12/2000
Analyses completed	09/2001
Report completed	12/2001
	/
Project End	12/2001

☐ Project Addresses Environmental Justice

If So, Description of How:

☒ Project Addresses Education/Outreach

If So, Description of How:

The results of this project will be provided to EPA and Ohio EPA for use in their models of contaminant effects, to the Black River RAP and Lake Erie LaMP Task Force, for use in habitat plans, and to the Lake Erie Technical Committee to provide information on forage fish. We will also present results and provide reports to the Lower Great Lakes Fishery Resources Office of the US Fish and Wildlife Service and to the Ohio Division of Wildlife for educating resource agencies on the effects of exotic species and emerging fisheries issues. In addition, professional presentations and a manuscript will aid in disseminating the results of this project.

Project Budget:

	Federal Share Requested ($)	Applicant's Share ($)
Personnel:	11,500	17,000
Fringe:	3,500	7,000
Travel:	3,000	7,200
Equipment:	8,600	0
Supplies:	2,100	2,000
Contracts:	16,900	0
Construction:	0	0
Other:	2,200	1,800
Total Direct Costs:	47,800	35,000
Indirect Costs:	18,588	0
Total:	66,388	35,000
Projected Income:	0	0

Funding by Other Organizations (Names, Amounts, Description of Commitments):

GLSC/USGS is providing $35,000 in operations and technical salaries, plus a commitment for salaries of full time research biologists (including an invertebrate biologist, fishery ecologist, and population biologist). GLSC is also supplying a 22' Boston whaler dedicated for this project.

Description of Collaboration/Community Based Support:

Collaboration with Central Great Lakes Mapping Coalition (key collaborators: Dr. Scudder Mackey, Ohio Division of Geological Survey; Mr. Rick Pavey, Ohio Division of Geological Survey) providing detailed side-scan sonar maps of nearshore areas.

Collaboration with USGS-Geologic Division (key collaborators: Dr. Byron Stone, Chief, Central Great Lakes Surficial Geology Project; Dr. Chuck Holmes; Dr. Wayne Newell) providing geologic characterization of bottom substrates including sedimentary dynamics, and isotopic dating of sediment cores to reconstruct historical erosion and deposition dynamics. Core samples will also provide 'pollution history' of these areas.